



# PIER Energy-Related Environmental Research

Environmental Impacts of Energy Generation, Distribution and Use

## A Life Cycle Assessment of Wildland Biomass for Electric Power

**Contract #:** 500-03-019

**Contractor:** U.S. Department of Agriculture – Forest Service

**Contract Amount:** \$2,000,000

**Contractor Project Manager:** Dr. Mark Nechodom

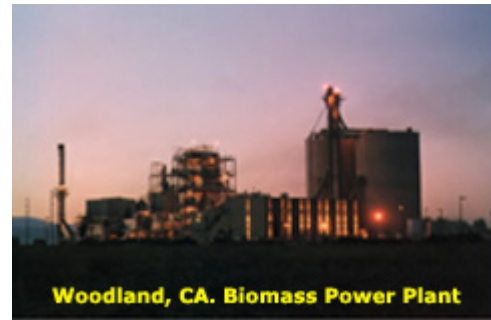
**Commission Contract Manager:** Linda Spiegel

### Purposes

The purposes of this contract with USDA Forest Service are to: (1) construct a life cycle assessment<sup>1</sup> model of the use of by-products generated from in-forest fuels treatments<sup>2</sup> for biomass power; (2) evaluate thinning treatment effects on forest health and watersheds and help determine how best to mimic natural fire regimes; and, (3) determine future research needs.

### The Issue

California has pioneered renewable energy development for decades, yet changes in the energy landscape and public opposition to some renewables approaches has challenged that position. Biomass energy in particular has experienced a tumultuous history within California. In a ten-year period beginning in 1980, the state went from less than 80 megawatts (MW) of biomass-based generating capacity to about 820 MW.<sup>3</sup> Since that peak, the total generating capacity has fallen, and although the total percentage of electricity generated by biomass has risen slightly each year since 1999, the number of operating biomass plants in the State has dropped from 66 at the industry's heyday in the early 1990s to 35 in 2002.<sup>4</sup>



<sup>1</sup> *Life-cycle assessment* is defined by the Society of Environmental Toxicology and Chemistry as an objective process to evaluate the environmental burdens associated with a product or activity by identifying energy and materials used and wastes released to the environment, and to evaluate and implement opportunities to affect environmental improvements.

<sup>2</sup> *In-forest treatments* refers to activities other than commercial harvesting that produce biomass by-products (e.g., fuel-load-reduction activities).

<sup>3</sup> Simons, G. et. al. 1999. Biomass Energy RD&D Needs and Directions in California under a Deregulated Electricity Market. In: *Biomass: A Growth Opportunity in Green Energy and Value-added Products*. Overend, R. P. and E. Chornet, eds. Oxford: Elsevier Science Ltd.

<sup>4</sup> Morris, G. December 2002. *Biomass Energy Production in California 2002: Update of the California Biomass Database*. National Renewable Energy Laboratory. NREL/SR-510-3111.

In 2002, the California Legislature passed into law SB 1078,<sup>5</sup> a Renewable Portfolio Standard which requires certain retail sellers of electricity to procure 20% of their generating electricity from renewable sources by 2017. Biomass energy production is expected to play a significant role in helping to meet that target. However, it is equally important to ensure that biomass energy be developed in a manner that provides the maximum environmental benefits to the State.

The use of biomass as an energy source can improve air and water quality, as well as provide environmental benefits that other renewable energy sources cannot, such as preferable disposal options, improved forest health, and reduction of catastrophic wildfires. However, these environmental benefits are not yet realized in the economies of scale in the current market. Costs of fuel collection, transport, and processing—as well as the smaller capacity of biomass facilities in comparison to state-of-the-art power plants—prevent biomass generation from being cost competitive. Nevertheless, when the collateral environmental benefits are figured into economic analyses, biomass generation can be cost-competitive with traditional types of energy production. The use of biomass fuel from in-forest fuel treatments is the least understood of this environmental economic analyses, due to incomplete data and analyses. Yet, the volume of biomass from this source (estimated at 16 to 30 million bone dry tons annually) would be about four to eight times the current biomass volume from all sources consumed for biomass power production in California. Therefore, there is a need to focus research on ways to help incorporate all of the impacts and benefits of biomass energy production into economic and environmental analyses, to enable decision makers to evaluate California biomass production more accurately.

Excessive forest and wildland fuel loading from dense vegetation growth in California has resulted in significant public safety risks and wildland destruction from catastrophic events. These fire events cost the state billions of dollars annually. Costs for firefighting and damages from the 2003 end-of-season Southern California fires alone are estimated at more than \$2 billion.<sup>6</sup>



Prescriptions for thinning forests and wildlands to reduce fuel loading are not well defined and are an issue of significant controversy. Determining how much biomass needs to be removed from those ecosystems to achieve environmental and economic benefits and improve forest health is key to resolving that controversy. A growing number of isolated studies are trying to determine best strategies for removing fuel in a manner that mimics natural fire regimes. These studies will complement the goal to promote an environmentally acceptable, scientifically sound production of energy resources from California's wildlands.

<sup>5</sup> SB 1078, Sher, Chapter 516, Statutes of 2002.

<sup>6</sup> Garrison, J., and N. Vogel. October 29, 2003. "Firefighting Costs Further Strain Local Governments." *Los Angeles Times*.

## Project Description

In this project, PIER-EA is funding work led by the USDA Forest Service to develop a life-cycle assessment (LCA) model that could help stakeholders assess the environmental and economic life-cycle impacts and benefits of using forest fuels treatment by-products for biomass power. The project will also help determine the best thinning treatments to promote forest health.

The Forest Service will engage expertise from the Pacific Southwest Research Station, the Energy Commission, the California Department of Forestry and Fire Protection (CDF), the California Department of Fish and Game, the California Air Resources Board, academic institutions, TSS Consultants, and industry and environmental groups to:

1. critically review and synthesize existing studies to determine what research is necessary to populate the economic and environmental modules of the life-cycle assessment model;
2. develop a life-cycle assessment model to calculate the impacts and benefits of fuels treatments for use in biomass power generation in California;
3. develop a specific in-depth research portfolio to fill critical gaps in the model; and
4. produce and analyze a series of California-specific environmental and economic policy scenarios using the finalized model.

To help ensure that this work draws from the rich expertise available in the State and that the model and other results will be applied by stakeholders, the Forest Service will solicit input from policy and technical experts to accommodate the policy and political sensitivities inherent in resource economics, modeling costs and benefits, and non-market valuation.

Once the LCA model is developed, researchers will produce and analyze a series of economic and policy scenarios about the use of wildland biomass for power generation in California. The scenarios will reflect a range of policy options, as well as a range of biomass removal and biomass power technologies that reflect the diverse and site-specific ecosystem issues present in California.

## PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objectives:

- **Improving the energy cost/value of California's electricity.** This research and the resulting model will help the State's decision makers analyze the costs, benefits, and trade-offs inherent in the use of wildland biomass for electrical generation.
- **Providing environmentally sound electricity.** By being able to model different environmental scenarios for different regions, decision makers will be better able to decide whether the benefits of harvesting and using biomass in a particular area outweigh the impacts to the biota that inhabit those forests.
- **Providing reliable electricity.** California has shown that its capacity for biomass production far exceeds that which is currently being employed. As the state's electricity producers explore renewable generation options to meet the State's RPS, biomass generation provides a

near-term alternative. It also helps diversify the State's generation resources at a time of rising natural gas prices.

### **Final Report**

A prototype model and reports on forest treatments research needs will be available in 2005. A series of California-specific environmental and economic policy scenarios using the finalized model and results on site-specific forest ecosystems studies will be completed by 2007. PIER-EA staff intend to post the final report on the Energy Commission website after that time, and will list the website link here.

### **Contact**

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